

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

60.19
-762
p. 2

U.S. DEPT. OF AGRICULTURE
LIBRARY
MAR 3 - 1962
CURRENT SPECIAL SERVICES



RANGE IMPROVEMENT

VOL. 6, NO 1

NOTES

JAN. 1961

INDEX	
Water Spreading for a More and Better Forage	1
Soil as a Factor Influencing Range Research	3
A Practical Range Water Development Headbox	12

(AGRI - OGDEN)

STATEMENT OF PURPOSE

- - - -

This publication is printed primarily to inform professional range administrators of important range improvement and management developments and findings. These "Notes" may include extracts of published papers, unpublished preliminary reports of research work, unpublished reports on administrative studies, and personal observations or suggestions of other range administrators. No claim is made as to the accuracy or completeness of studies or conclusions drawn.

All who read these RANGE IMPROVEMENT NOTES are encouraged to submit material for publication, or suggestions for improving its usefulness. Full credit will be given for any material used.

WATER SPREADING FOR MORE AND BETTER FORAGE*

- - -

Returns from extra forage produced by water spreading, an ancient irrigation practice still used profitably in the dry West, can be several times greater than annual maintenance costs.

This was indicated in studies by ARS range conservationist W. R. Houston. Average yields of blue grama grass more than tripled and those of western wheatgrass almost doubled after runoff water from heavy rain was diverted to flood rangeland near Miles City, Montana.

In earlier experiments, scientists noted that one range produced up to 34 times more forage when flooded than when not flooded. In Houston's studies, yield increases varied from 38 percent for western wheatgrass to 648 percent for blue grama grass - depending on duration of flooding and how well the land was irrigated.

Obvious benefits of the method - improved yields and quality of forage - are well recognized, but little was known about costs and returns. Research by Houston and others is providing this information.

The initial costs have varied from 36 cents to \$30 an acre. Montana station scientists report that \$1,649 (\$1.38 an acre) was spent on ditches and dikes in the 1,200-acre area where Houston

*Condensed from an article in AGRICULTURAL RESEARCH

Vol. 8 - June 1960 - No. 12

conducted his experiments. Accumulated maintenance costs were \$465, making the total \$2,114.

By prorating this total over 900 acres used in his studies, Houston arrives at a per-acre cost of \$2.35 or 29 cents an acre a year for the 8 years the spreading system has been operated.

What does water spreading pay annually? Houston's figures show that spending 29 cents an acre doubled or tripled average yields and increased gross income \$2 to \$3 an acre - a 7- to 10-fold return.

Several factors are considered in establishing a water-spreading system, notes Houston. Among these are type, slope and depth of soil, amounts and kinds of soil salts, size and slope of the watershed, storms that encourage flooding, and whether the water contains excess silt to inhibit grass growth or fill the spreader system.

-o0o-

The world's first range conservation commemorative postage stamp will be issued February 2, 1961, at Salt Lake City, Utah. The 4-cent stamp, printed in three colors, will be released at the annual meeting of the American Society of Range Management.

-o0o-

SOIL AS A FACTOR INFLUENCING RANGE RESEARCH

(Excerpts from a paper by Robert A. Gardner ^{1/})

- - -

In this discussion on soils, emphasis is given to soil characteristics and qualities and to certain principles that should prove useful as an outline for the range scientist. Soil science is a complex field in itself, although closely allied with plant science and an integral part of ecology. For this reason, the range scientist, unless he can also qualify as a soil scientist, is well advised to join or consult with a soil scientist in carrying out research involving the recognition and measurement of soil differences.

Factors of Soil Formation

Less is known today of soils in broad areas used as range than in areas used for any other purpose. Enough is known, however, to indicate a great diversity of soils, which is to be expected because of wide differences in the natural factors of soil formation. These are climate, living matter, parent material, relief, and time. More specifically, the natural characteristics of a soil at any one place are due to the integrated effect of climate and living matter, acting on soil parent material, as conditioned by relief, over a period of time.

It would be a mistake to attempt to characterize range land in general according to some particular combination of the factors of

^{1/} Soil Scientist (Soil-Vegetation Survey Project), California
— Forest and Range Experiment Station.

soil formation. No one combination is typical; actually, there are as many combinations as there are distinctive soils. Climate and living matter vary from those characteristic of the hot desert of the Southwest to those of near tundra conditions in the high Rocky Mountains, or to those of high rainfall areas along the Pacific Coast. Soil parent material is highly variable, in composition as well as mode of formation. Relief varies from nearly flat basins or plains to perpendicular cliffs. And time of soil formation varies from almost zero, such as for soils of recent alluvium, to many thousands of years for soils of ancient land surfaces.

In addition to natural factors, man's activity also must be considered as a significant modifying factor. Soil changes brought about by man-induced erosion, severe soil compaction from livestock trampling or equipment use, soil moisture changes from gullying and drainage, and plant-nutrient changes through fertilization, to list a few, may be of profound importance in relation to kind and amount of forage production.

Soils may be differentiated in several ways, depending on objectives. Three commonly used ways, actually interconnected, are: (1) Portions of soils classed simply according to differences in one property, such as differences in texture or color or reaction, (2) soils classed according to their qualities or attributes, as manifest

in behavior or performance, such as erodibility, moisture retentivity, permeability, fertility, or productivity, (3) entire soils existing as natural units of the landscape classed according to distinctive and relevant combinations of a number of soil characteristics, such as is done in the natural system of soil classification.

The broad objective of the natural system of soil classification is to provide a means of organizing knowledge of soils as they exist in the landscape. The principles of classification are as applicable in range areas as in cultivated areas, and one of the chief uses of the system is for predicting soil behavior or performance for many purposes. In this regard, it serves as a means of relating the differentiating characteristics of a soil to its various qualities, to the degree that our state of knowledge permits such interpretations of qualities to be made.

Common Differentiating Characteristics of Soils

The following characteristics include those commonly used in developing criteria for differentiating soils at and below the soil series level.

1. Thickness of horizons and soil depth. - Thickness of horizons is usually measured in inches and perpendicular to the soil surface. Thickness of soil is the summation of the thickness of horizons regardless of ease or suitability for root growth and penetration. The term "soil depth" commonly has a more practical meaning and refers to that portion of the soil from the surface downward to the underlying bedrock, hardpan, consolidated substratum, or other material that would either greatly restrict root distribution or greatly reduce soil moisture and nutrient supply.

2. Arrangement and number of horizons. - Relative position of the horizons in the soil profile and number or presence of distinctive horizons; degree of gradation from one horizon to an adjacent horizon below.
3. Structure of horizons. - Soil structure refers to the aggregation of primary soil particles into compound particles, or clusters of primary particles, which are separated from adjoining aggregates by surfaces of weakness. Structure is an extremely important characteristic of soils because of its influence on soil permeability, erodibility, and productivity. No other management problem pertaining to soils in range areas is so important as the maintenance, restoration, or improvement of structure at the soil surface.
4. Color of horizons. - Color is the most obvious characteristic of soils. It has little to do with soil behavior, but differences in color may be indicative of important quality differences not easily recognized.
5. Texture of horizons. - Soil texture refers to the relative proportions of the various size groups of individual soil grains (sands, silt, and clay) in a mass of soil. Texture is one of the less easily changed characteristics of soil and has an important influence on soil behavior. Differences in moisture retentivity, permeability, erodibility by wind, and workability are commonly related to differences in texture.
6. Consistence of horizons. - Soil consistence refers to the degree of cohesion and adhesion or the resistance to deformation or rupture expressed by soil material. Terms such as cemented, compact, hard, soft, loose, friable, firm, plastic, and sticky, are used to denote soil consistence. Consistence of most soils varies with moisture; a particular kind of clay soil may be extremely hard when dry, very firm when moist, and very sticky when wet. Changes in consistence of the soil surface, for example from friable to very firm (along with a change in structure) because of compaction, may have an important influence on soil behavior.
7. Reaction and base status of horizons. - Soil reaction refers to the degree of active acidity or alkalinity of the soil. It is probably the most important single chemical test that is made of soils

because of its general importance in connection with the growth of plants. It is measured according to pH values, usually by colorimetric method in the field and by electrometric method (glass electrode) in the laboratory.

8. Soluble salts in horizons. - Excesses of soluble salts, which characterize saline soils and which commonly occur in alkali soils, have a tremendous influence on kind and amount of plant growth. A saline soil contains enough soluble salts so distributed in the profile that they impair productivity or affect the kind or amount of plant growth.

The kinds of salts are also important. The most common are sodium chloride, sulfate, carbonate, and bicarbonate; magnesium sulfate and chloride; and calcium sulfate and chloride. The different kinds and amounts of salt not only influence plant growth; they also have an influence on other characteristics of the soil. For example, some alkali soils containing sodium carbonate and bicarbonate are not only very strongly alkaline in reaction but commonly tend to disperse on wetting and to become compact and very hard on drying.

9. Organic matter in horizons. - Organic matter is important usually in the upper or near-surface horizons. It includes freshly fallen litter as well as decomposed matter, either occurring as a distinct organic horizon or mixed with mineral matter. Organic soils (or horizons) contain 30 percent or more organic matter and mineral soils (or horizons) less than this. Relative differences in organic-matter content of mineral soil horizons within a profile usually can be detected in the field, mainly by differences in color. Total nitrogen content of the soil is also commonly determined since the carbon-nitrogen ratio of organic matter is an important characteristic of soils as well as an indicator, along with other characteristics, of fertility status.
10. Mineralogical composition of horizons. - The mineralogical composition of soil horizons is in part dependent on the mineralogical composition of the soil parent material and in part dependent on kinds of processes of soil formation and the length of time these processes have gone on.
11. Character and geology of soil parent material. - Certain soil qualities are more readily inferred from type of parent material or parent rock than from any other characteristic. For example,

some soils contain sufficient selenium to produce troublesome concentrations in certain forage plants; these soils in places are developed in weathered material of identifiable sedimentary rock formations, which in themselves contain selenium.

Soils formed in place from decomposition of bedrock are differentiated as to kind of rock, such as granite, basalt, rhyolite, sandstone, shale, limestone, and metamorphic equivalents. Also, soils on soft sedimentary rocks are differentiated from those on hard rocks. Hydrologic studies of watersheds make particular use of information on character and geology of soil parent rock material.

12. Slope. - Although slope gradient is the most common basis for differentiation, other characteristics of slope, such as shape and length may be of specific importance in places. Slope is of particular importance in connection with surface runoff and erodibility of a soil. The relative influence of slope on erodibility, however, is dependent on other characteristics of the soil.
13. Erosion. - As a differentiating soil characteristic, erosion as used here refers to soil truncation that has occurred through accelerated, or man-induced erosion, not to the eroded material. It should not be confused with erodibility of a soil, since some soils relatively resistant to erosion may be severely eroded in places under severe use, whereas other highly erodible but protected soils may not be eroded at all. It is also important to distinguish between past erosion and present or active erosion. Usually active erosion manifests itself by observable changes at the soil surface, even though total soil loss from an area may be but slight at the time of observation. Also, erosion of one soil may damage production far more than the same amount of erosion of another kind of soil.
14. Drainage. - Differences in drainage of many soils are reflected in differences such as organic-matter content and color pattern. Some soils, however, must be differentiated solely by observed differences in drainage, such as frequency and duration of overflow or duration and height of water table. Also, some soils may exhibit characteristics indicating that they have formed under poorly drained conditions, and yet at the present time they are well-drained. Some mountain meadows have become better drained through gully development. In many places this has been detrimental because of a resulting change to inferior plant cover.

15. Rockiness and stoniness. - Rock outcrops and stones larger than 10 inches in diameter are not considered part of the soil mass proper but may be of great importance in the use of soils.

Some Important Soil Qualities

Soil qualities are those behavior or performance characteristics that are inferred through interpretation of the differentiating characteristics of soils, or that are attributed to a particular kind of soil. Such qualities can be predicted only to the degree that soil behavior has been observed or measured and related to the differentiating characteristics or to kind of soil. Also, these predictions can only be as accurate as the relationships established are accurate. With such information, different kinds of soils can be grouped into a number of interpretive classes of direct value in use and management decisions.

Soil qualities of particular importance in connection with research on use of ranges include erodibility, moisture retentivity, permeability, fertility, and productivity. Other qualities, such as compactibility, workability, irrigability, and drainability may be important in connection with some soils for certain range research purposes.

1. Erodibility. - Erodibility refers to the relative susceptibility of a soil to erosion. In considering erodibility, two aspects are necessarily involved: (1) Characteristics of soils that pertain to their relative stability or instability, and (2) the degree of soil or vegetation disturbance, in relation to these characteristics, that would accelerate erosion.
2. Moisture retentivity. - Moisture retentivity refers to the moisture retaining power of soil at specified levels of moisture tension. Three levels are commonly used: Saturation, field capacity, and

permanent wilting point. . . So called "available soil moisture" ordinarily refers to the amount of moisture a soil can contain between its permanent wilting point and field capacity. Soil texture (as well as content of coarse fragments) has a greater influence on moisture retentivity of mineral soils than other characteristics, although in some soils organic-matter content or kind of silicate clay, as well as other characteristics, may have important influences.

3. Permeability. - Permeability is that quality of soil relating to the readiness with which it conducts or transmits fluids. Ordinarily it refers to a quality of soil horizons, but for some simplification purposes the permeability of the least permeable horizon of a soil (except for the immediate surface layer) is used to denote the permeability class of the whole soil.

Infiltration rate, or the rate of surface water entry into a soil, is governed by the least permeable layer of the wet soil. Not uncommonly in soils of range areas, this limiting layer is at the immediate surface, where permeability can be greatly influenced by changes in structure and compaction.

4. Fertility. - Soil fertility is the quality that enables a soil to provide the proper kinds and amounts of nutrients for the growth of specified plants, when other growth factors are favorable. Nitrogen, phosphorus, and potassium are most commonly tested for in routine work and less commonly sulfur, calcium, and minor elements. Soils also react differently to fertilizers. Some soils fix significant amounts of phosphate; others fix little or none. Continued applications of sodium nitrate to alkaline soils that already contain appreciable exchangeable sodium can increase the sodium to harmful amounts. In considering soil fertility in range research, it should be kept in mind that quality as well as amount of forage is important.
5. Productivity. - Soil productivity pertains to the capability of a soil for producing specified plants under specified management practices. The distinction between soil fertility and soil productivity needs to be clearly understood, and some examples may be helpful. A soil only a few inches deep may be fertile and yet nonproductive for specified plants simply because of insufficient soil. Or, a fertile soil may become so compacted that its productivity is greatly lowered. Also, the factor of management enters into soil productivity. A certain soil may have one

productivity level for forage production where there is but little control of livestock, another level where there is careful control over number of animals and grazing time, another where fertilized, another where both seeded and fertilized, and still another where seeded, fertilized, and irrigated. This increase in management intensity, of course, assumes suitability of the soil for these management levels. The other side of the management picture must also be considered - those practices which reduce productivity and may in time permanently damage forage production capacity. General discussions of soils in relation to grass production are given in the Yearbook of Agriculture, Grass (8, 11).

-o0o-

A man cannot live a full and satisfying life until he is prepared to accept the unexpected as an opportunity instead of a possible source of trouble.

-o0o-

Diplomacy is the business of handling a porcupine without disturbing its quills.

- - -

A PRACTICAL RANGE WATER DEVELOPMENT HEADBOX

William M. Dix*

- - -

At many locations there is a need for a clean, dirt proof, rodent proof, tasteless spring headbox for range water development.

When wooden forms are used in installing a concrete headbox, much time is required, and the inside forms often taint the water. Considerable time and money, estimated at \$25.00 per installation has been saved by using discarded steel drums as forms. On the Burley Ranger District of the Sawtooth National Forest, three to four installations per year have been made and found to be very successful. The headboxes should last indefinitely.

Materials needed:

1. Standard 55 gal. drum. The ends can be cut out or the drum cut to the needed height, using a sharp cold chisel and a hammer.
2. Fifteen gal. drum. These can be obtained from service stations (transmission and gun grease drums). The drum should be burned out before using. Cut to proper size after it has been burned out.
3. Large tapered metal dishpan, minimum bottom diameter 13 inches.
4. Old horseshoe with ends bent to serve as handle for the lid.
5. Large tin can (4" x 7") to fit in sides of drum where the water source is from the side.

*Ranger District Assistant, Burley, Idaho

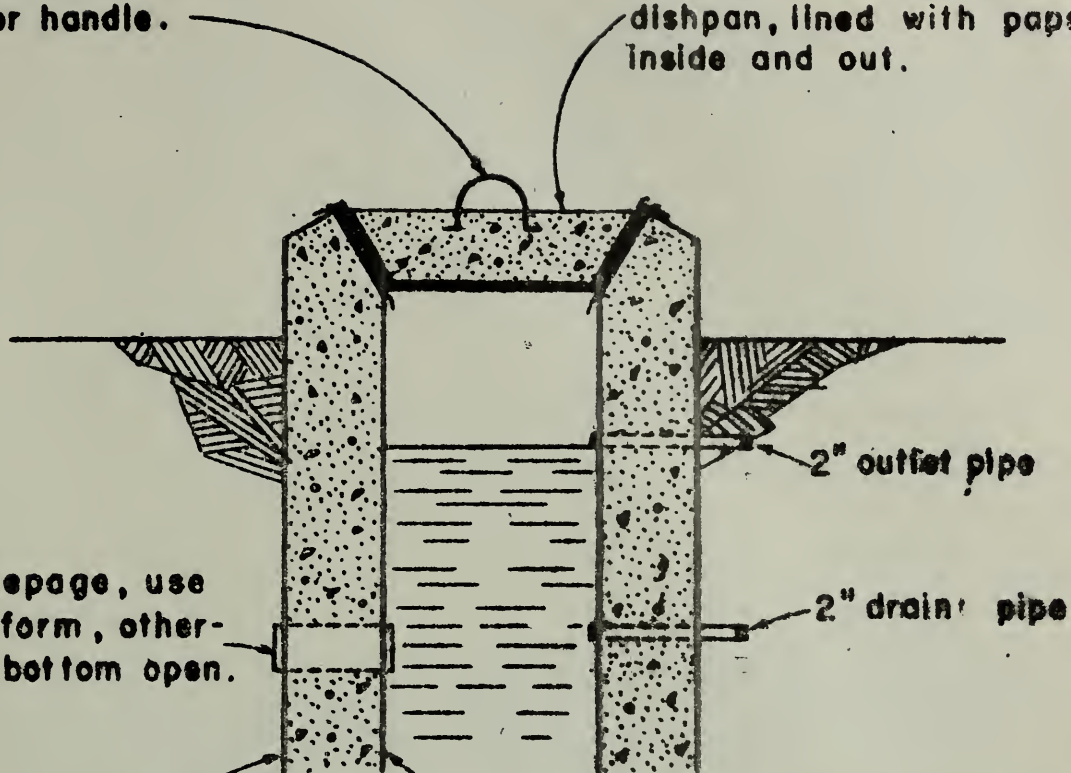
Bent reinforcing bar or old horseshoe for handle.

For lid form, use a metal dishpan, lined with paper, inside and out.

For side seepage, use tin can as form, otherwise, leave bottom open.

Std. 55 gallon drum for outside form.

Std. 15 gallon drum for inside form. Ends cut out with a cold chisel.



1. Pour cement to level of inside drum.
2. Set dishpan in place and fill with cement.
3. Pour top of wall.

SPRING DEVELOPMENT OIL DRUM HEADBOX

No Scale

